NASA/TM—2000–209891, Vol. 225

Te Report Se on the
B osystem-A sphere Study (BOREAS)

ll and Sara K. Conrad, Editors

225
AS TGB-1/TGB-3 NEE Data

o and T.R. Moore

nautics and
stration

ce Flight Center
ryland 20771

Nov

The NASA STI Program Office ... in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the lead center for NASA's scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

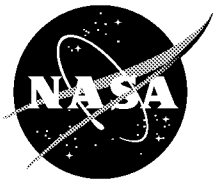
- TECHNICAL PUBLICATION. Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA's counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.
- TECHNICAL MEMORANDUM. Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.
- CONFERENCE PUBLICATION. Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or cosponsored by NASA.
- SPECIAL PUBLICATION. Scientific, technical, or historical information from NASA programs, projects, and mission, often concerned with subjects having substantial public interest.
- TECHNICAL TRANSLATION. English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that complement the STI Program Office's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results . . . even providing videos.

For more information about the NASA STI Program Office, see the following:

- Access the NASA STI Program Home Page at http://www.sti.nasa.gov/STI-homepage.html
- E-mail your question via the Internet to help@sti.nasa.gov
- Fax your question to the NASA Access Help Desk at (301) 621-0134
- Telephone the NASA Access Help Desk at (301) 621-0390
- Write to:
  NASA Access Help Desk
  NASA Center for AeroSpace Information
  7121 Standard Drive
  Hanover, MD 21076-1320

NASA/TM—2000–209891, Vol. 225



Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Sara K. Conrad, Editors

Volume 225

BOREAS TGB-1/TGB-3 NEE Data over the NSA Fen

Lianne Bellisario, Atmospheric Environment Service
Tim R. Moore, McGill University, Montreal, Quebec

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

November 2000

Available from:

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320
Price Code: A17

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Price Code: A10

BOREAS TGB-1, TGB-3 NEE Data over the NSA Fen

Lianne Bellisario, Tim R. Moore

Summary

The BOREAS TGB-1 and TGB-3 teams collected several data sets that contributed to understanding the measured trace gas fluxes over sites in the NSA. This data set contains NEE measurements collected with chambers at the NSA fen in 1994 and 1996. Gas samples were extracted approximately every 7 days from chambers and analyzed at the NSA lab facility. The data are provided in tabular ASCII files.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS TGB-01/TGB-03 NEE Data over the NSA Fen

1.2 Data Set Introduction

The Trace Gas Biogeochemistry (TGB)-01 and -03 teams took net ecosystem exchange of CO_2 (NEE) measurements at the Northern Study Area (NSA) fen site using chambers from early June to September 1994 and from April to late October 1996 for the BOReal Ecosystem-Atmosphere Study (BOREAS). Chamber NEE measurements were taken at the four subsites within the fen in the NSA to determine the NEE rates at these locations. The locations represent the range of plant communities, water chemistry, and peatland types found in northern peatlands, including bog, rich fen, poor fen, and collapse scar (pH ranges from 3.8 to 7.2). Continuous measurements of water level and air and soil temperatures were taken to understand the thermal and hydrological gradients associated with each plant community. Measurements were made from the period of snow melt and thaw through the full growing season to fall freeze up to examine the seasonal patterns of NEE, differences in phenology, and relative importance of vascular plants and bryophytes to the carbon balance. The following is a description of the acquisition of data and the final data sets.

1.3 Objective/Purpose

The purpose of these measurements was to examine the range and magnitude of NEE between the atmosphere and the wetland plants and soils. Continuous measurements of water level and air and soil temperature measurements were also made to understand the environmental controls on NEE. Plant species composition within the NEE collars was measured to understand the differences in NEE among the various plant communities in the fen.

1.4 Summary of Parameters

NEE, air and water temperatures, and water levels were measured in the NSA fen. In addition, the plant communities for each chamber were characterized.

1.5 Discussion

NEE was measured at four subsites in the NSA fen, designated as collapse bog (CB), collapse fen (CF), tower fen (TF), and Zoltai fen (ZF). Each collar location is further designated by a spur (1, 2, 3, or 4) along the boardwalk at each subsite and by the microtopography or dominant ground cover of the collar location: pal=palsa, hk=hummock, hw=hollow, lwn=lawn, moat=open water at the edge of the collapse scars, b_moss=brown moss, sph=sphagnum, and lich=lichen. NEE, dark CO_2 flux (respiration), photosynthesis (derived from the difference between NEE and respiration), and photosynthetically active radiation (PAR) are the parameters for the NEE data files. Continuous water table and temperatures were recorded at each of the subsites to accompany the NEE measurements. Temperatures of the air, 5-cm, 10-cm, 20-cm, and 50-cm peat depth were measured at each subsite. Temperatures correspond to the collar location at the subsite. In cases where the continuous data were missing, manual soil temperatures were recorded. Continuous water level measurements were taken at each subsite and are designated by the subsite abbreviation and the number of the spur (e.g., CBWL1=collapse bog, water level, spur 1). Plant species composition of each NEE collar was recorded as percent cover of the total collar area.

1.6 Related Data Sets

BOREAS TGB-01 CH4 Concentration and Flux Data from NSA Tower Sites
BOREAS TGB-01/TGB-03 Water Table and Peat Temperature Data over the NSA
BOREAS TGB-01/TGB-03 CH4 Chamber Flux Data over the NSA Fen
BOREAS TGB-03 Plant Species Composition Data over the NSA Fen

2. Investigator(s)

2.1 Investigator(s) Name and Title

Dr. Jill L. Bubier
Research Associate
University of New Hampshire

Dr. Patrick M. Crill
Research Associate Professor
University of New Hampshire

Dr. Tim R. Moore
Professor
McGill University

2.2 Title of Investigation

Magnitude and Control of Trace Gas Exchange in Boreal Ecosystems

2.3 Contact Information

Contact 1:
Dr. Jill L. Bubier
Institute for the Study of Earth, Oceans, and Space
Complex Systems Research Center
University of New Hampshire
Durham, NH 03824
(603) 862-4208
(603) 862-0188 (fax)
jill.bubier@unh.edu

Contact 2:
Dr. Patrick M. Crill
Institute for the Study of Earth, Oceans, and Space
Complex Systems Research Center
University of New Hampshire
Durham, NH 03824
(603) 862-3519
(603) 862-0188 (fax)
patrick.crill@unh.edu

Contact 3:
Ruth K. Varner
Research Scientist
Institute for the Study of Earth, Oceans, and Space
Complex Systems Research Center
University of New Hampshire
Durham, NH 03824
(603) 862-2939
(603) 862-0188
ruth.kerwin@unh.edu

Contact 4:
Dr. Tim R. Moore
Geography Department
McGill University
805 Sherbrooke St. W.
Montreal, Quebec H3A 2K6
Canada
(514) 398-4961
(514) 398-7437 (fax)
moore@felix.geog.mcgill.ca

Contact 5:
Jeffrey A. Newcomer
Raytheon ITSS
Code 923
NASA GSFC
Greenbelt, MD 20771
(301) 286-7858
(301) 286-0239 (fax)
Jeffrey.Newcomer@gsfc.nasa.gov

3. Theory of Measurements

Chamber fluxes measure the changes in mixing ratio of trace gases (CO_2) in a closed headspace over a period of time. This headspace is isolated from the atmosphere; therefore, the exchange of material between the covered soil and the headspace can be quantified.

4. Equipment

4.1 Sensor/Instrument Description

NEE was quantified with a LI-COR (LI-COR, Inc., Lincoln, NE) portable photosynthesis system (LI-6200), which includes the LI-6250 infrared gas analyzer (IRGA), system console with 256 K memory, 9960-035 Sensor Housing, 6000TC leaf temperature thermocouples, a Vaisala HUMICAP humidity sensor, quantum sensor for PAR measurements, field stand, 6000B rechargeable battery packs, 6200B rechargeable battery packs, LI-6020 battery charger, 6200DP desiccant tubes for magnesium perchlorate, 1000-90 communications software, 6200-25 support software, and RS-232C output leads for Data Terminal Equipment (DTE) and Data Communication Equipment (DCE). A wood frame backpack for carrying the LI-6200 and ancillary equipment to the field sites was designed and manufactured by George Stone at Arundo Woodworking, Hyde Park, Vermont.

The portable climate-controlled chambers were designed by Patrick Crill, Paul Carroll, and Ruth Kerwin and were modeled after a chamber described in Whiting et al., 1991. The chambers were manufactured at University of New Hampshire (UNH) by Ruth Kerwin and were constructed of clear Lexan and Teflon film to allow maximum light penetration. One of two chamber sizes was used depending on the height of the vegetation. The larger chamber covered 3,660 cm^2 of surface area and was 90.5 cm in height. The aluminum frame was covered on three sides with 5-mil Teflon film. The fourth side was constructed of a rigid polycarbonate wall (1/8" Lexan) on which the climate control and sampling equipment were mounted. The chamber top was made of 1/8" Lexan and was removable to allow equilibration of plant communities to ambient conditions between sampling runs. The climate control system consisted of a small heat exchanger (radiator) and a cooler for pumping cold water. The cooler was filled with water, ice, and a battery-powered pump and attached to the chamber with hoses to circulate the cold water to the heat exchanger. Three small brushless fans circulated the air across the radiator, cooling the enclosed air to within 1 °C of ambient air temperature outside the chamber. The smaller chamber covered the same area as the larger chamber to fit the same collars (3,660 cm^2), but was half the height (45 cm). All four sides and top of the smaller chamber were constructed of 1/8" Lexan. In order to measure NEE at different light levels, shrouds of different mesh size were used to reduce the light entering the chamber to 1/2, 1/4, and 0 full light. The aluminum collars were designed by Patrick Crill and manufactured at UNH. The collars were inserted into the peat in the fall of 1995 to minimize disturbance during the sampling period beginning in the spring of 1996.

Continuous water table measurements were made with a float and counter weight attached to a wheel and potentiometer mounted on a platform that rested on top of a wooden post anchored in the clay below the peat. The potentiometer, which was wired to either a CR10 or CR7 datalogger (Campbell Scientific, Inc., Logan, UT), recorded the change in water level in mV. Wells were constructed of PVC tubing. Peat temperatures were recorded with type T thermocouples (copper-constantan) attached at four levels (5, 10, 20, and 50 cm) to wooden stakes and inserted into the peat during the fall of 1995. The thermocouples were wired to either CR10 or CR7 dataloggers and calibrated to reference temperatures.

4.1.1 Collection Environment

The chamber fluxes were collected under all environmental conditions. The calibrations and data analyses were completed at the Heritage North Museum laboratory in Thompson, Manitoba.

4.1.2 Source/Platform

Ground.

4.1.3 Source/Platform Mission Objectives

The objective was to determine the plant-soil-surface exchange rates of CO_2 at the NSA fen complex.

4.1.4 Key Variables

The key variables measured during the sampling period were NEE, PAR, air temperature, peat temperature at four peat depths, water table position, and plant species composition.

4.1.5 Principles of Operation

The LI-6200 portable photosynthesis system consists of a LI-6250 CO_2 IRGA, sensor head, and datalogger. The LI-6250 consists of an IRGA, a mass flow meter, and a pump. It can be configured for either absolute or differential modes of operation by rearranging the external plumbing. The analyzer was used in absolute mode. The CO_2 measurement is based on the difference in intensity of infrared radiation passing through two gas sampling tubes: a reference tube contains a known amount of CO_2, and a sample tube contains an unknown amount. Infrared radiation is transmitted through both paths, and the output of the analyzer is proportional to the difference in absorption between the two. The lead selenide detector is cooled and regulated to -12 °C by a thermoelectric cooler. To keep the detector housing free of water vapor and CO_2, a small bottle of magnesium perchlorate and soda lime is attached to the detector (LI-COR, Inc.).

4.1.6 Sensor/Instrument Measurement Geometry

Not applicable.

4.1.7 Manufacturer of Sensor/Instrument

Manufacturer of LI-6200 portable photosynthesis system:
LI-COR, Inc.
Box 4425
4421 Superior St.
Lincoln, NE 68504 USA
(402) 467-3576
(402) 467-2819 (fax)

Manufacturer of CR10 and CR7 dataloggers:
Campbell Scientific, Inc.
815 W. 1800 N.
Logan, UT 84321-1784 USA
(801) 753-2342
(801) 750-9540 (fax)

4.2 Calibration

4.2.1 Specifications

The IRGA was calibrated against Canadian Atmospheric Environment Services (AES) certified primary CO_2 standards acquired by the BOREAS project. Calibration in absolute mode was accomplished by flowing 0-ppm CO_2 through the analyzer (scrubbing of CO_2 with soda lime) and adjusting the zero potentiometer until the displayed reading was 0 ppm. Then the span was checked by flowing a known concentration of CO_2 through the analyzer and adjusting the span potentiometer until the displayed reading was correct. An AES standard of 397.3 ppm CO_2 was used for the span calibration. The analyzer was usually within 1-2 ppm of the known concentration. The zero and span were checked twice during each calibration.

4.2.1.1 Tolerance
None given.

4.2.2 Frequency of Calibration
The CO_2 analyzer was calibrated on a daily basis, every morning in the Heritage North Museum lab before going to the field sites. The zero was rechecked and calibrated several times during the day because it was sensitive to changes in air temperature.

4.2.3 Other Calibration Information
Not applicable.

5. Data Acquisition Methods

NEE was calculated using the change in concentration of CO_2 in the chamber headspace over a 2.5-minute sampling period. The IRGA sampled every 5 seconds and averaged the flux rate every 30 seconds. The CO_2 flux for each sampling run was calculated as a mean of the five 30-second sampling intervals during the 2.5-minute period. The total sampling period was kept very short to minimize the time the plants were exposed to the chamber environment. Temperature and relative humidity inside the chamber were monitored closely during each run to make sure that conditions did not change significantly during the sampling period. For every collar, separate sampling runs were conducted under full light, 1/2 light, 1/4 light, and dark conditions. Less than full light measurements were obtained by placing shrouds of different mesh sizes over the chamber. Grab samples of air for measuring CH_4 flux were taken during each dark run (see documentation file CH_4doc.doc for BOREAS TGB-01).

Temperature and water level were measured continuously and averaged every hour on the CR10 or CR7 dataloggers. Manual measurements of air temperature, peat temperature, and water table position were made at the same time as the NEE measurements.

Plant species composition was recorded in each collar during the height of the growing season in mid-July 1996. Visual estimates of percent cover of each vascular plant and bryophyte species were made based on light interception of the canopy of each species. Percent cover of all species totals over 100 percent for each collar because of several layers of vegetation. Specimens for each unknown species were collected in plant communities outside of the collars and identified in the lab at the Heritage North Museum, Thompson, Manitoba, or at Dr. Barry Rock's laboratory at Complex Systems Research Center, UNH, Durham, NH.

6. Observations

6.1 Data Notes
None given.

6.2 Field Notes
None given.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The collars were placed so as to cover the environmental gradients in the TF complex, an area approximately 6 km^2. Global Positioning System (GPS) coordinates based on the North Amercian Datum of 1983 (NAD83) for the major sampling locations are:

Site	NLat	SDev	WLon	SDev	Elev	SDev
Collapse Bog (CB)	55°55'4.931"	2.75	98°25'5.294"	1.18	217.20	3.86
Collapse Fen (CF)	55°54'59.959"	5.60	98°25'6.109"	1.90	218.40	7.62
Zoltai Fen (ZF)	55°55'5.477"	2.07	98°25'26.396"	1.29	217.10	3.11

Collapse Bog (CB) collars were located in a small, circular collapse scar (75 m diameter) almost completely surrounded by permafrost peat plateau, behind the generator shed. Three spurs were located perpendicular to the boardwalk. Spur 1 was adjacent to the moat, or open water lagg area; spur 2 was in a hummock-hollow area; and spur 3 was in the center of the collapse scar. In addition to the collars in the collapse scar, this subsite had two collars on the palsa (frozen peat plateau) adjacent to the collapse scar. Collar designations were as follows:

```
CB1moat   = collapse bog, spur 1, moat
CB2hk     = collapse bog, spur 2, hummock
CB2hw     = collapse bog, spur 2, hollow
CB3hk     = collapse bog, spur 3, hummock
CBpalmoss = collapse bog, palsa, moss
Cbpallich = collapse bog, palsa, lichen
```

Collapse Fen (CF) collars were located in a small, linear collapse feature that was east of and accessed from the main trail to the tower hut. Four spurs were located perpendicular to the main boardwalk. Spur 1 was located adjacent to the moat; spur 2 was in a uniform lawn of Sphagnum riparium; spur 3 was in a small treed ridge; and spur 4 was on the far edge of the collapse scar where the influence of groundwater was apparent. Collar designations were as follows:

```
CF1moat  = collapse fen, spur 1, moat
CF2lwn   = collapse fen, spur 2, lawn
CF3hka   = collapse fen, spur 3, hummock (a)
CF3hkb   = collapse fen, spur 3, hummock (b)
CF4bmoss = collapse fen, spur 4, brown moss
CF4sph   = collapse fen, spur 4, sphagnum
```

Tower Fen (TF) collars were located along the boardwalk to the micrometeorological tower in the NSA fen. Four spurs were located perpendicular to the main boardwalk. Spur 1 was just beyond the moat at the beginning of the boardwalk in a treed area of tamarack (Larix laricina), spur 2 was in a tall shrub zone (Betula glandulosa), spur 3 was in a low shrub zone just before the hut, and spur 4 was just beyond the hut in a mixed low shrub/sedge zone. Collar designations were as follows:

```
TF1hk = tower fen, spur 1, hummock
TF2hk = tower fen, spur 2, hummock
TF2hw = tower fen, spur 2, hollow
TF3hk = tower fen, spur 3, hummock
TF3hw = tower fen, spur 3, hollow
TF4hw = tower fen, spur 4, hollow
```

Zoltai Fen (ZF) collars were located in a sedge-dominated (Carex spp.) fen area of the peatland complex, north of the fen tower, and accessed from Rt. 391. Three spurs were located perpendicular to the main boardwalk. Spur 1 was on a treed ridge; spur 2 was in a shrub-dominated hummock-hollow area; and spur 3 was in a wet, sedge-dominated area near the edge of a palsa. Collar designations were as follows:

```
ZF1hk    = zoltai fen, spur 1, hummock
ZF2hk    = zoltai fen, spur 2, hummock
ZF2hw    = zoltai fen, spur 2, hollow
ZF3bmoss = zoltai fen, spur 3, brown moss
ZF3hw    = zoltai fen, spur 3, hollow (Sphagnum)
ZF3hk    = zoltai fen, spur 3, hummock (Sphagnum)
```

1994 NEE data from Lianne Bellisario:

```
CB1cL1 = collapsed bog, spur 1, carpet, collar 1
CB1cL2 = collapsed bog, spur 1, carpet, collar 2
CB1cL3 = collapsed bog, spur 1, carpet, collar 3
CB1cL4 = collapsed bog, spur 1, carpet, collar 4
CB1cL5 = collapsed bog, spur 1, carpet, collar 5

CF1cL1 = collapse fen, spur 1, carpet, collar 1
CF1cL2 = collapse fen, spur 1, carpet, collar 2
CF1cL3 = collapse fen, spur 1, carpet, collar 3
CF1cL4 = collapse fen, spur 1, carpet, collar 4
CF1cL5 = collapse fen, spur 1, carpet, collar 5

CF2nL1 = collapse fen, spur 2, lawn, collar 1
CF2nL2 = collapse fen, spur 2, lawn, collar 2
CF2nL3 = collapse fen, spur 2, lawn, collar 3
CF2nL4 = collapse fen, spur 2, lawn, collar 4
CF2nL5 = collapse fen, spur 2, lawn, collar 5

TF4wL1 = tower fen, spur 4, hollow, collar 1
TF4cL2 = tower fen, spur 4, carpet, collar 2
TF4cL3 = tower fen, spur 4, carpet, collar 3
TF4kL4 = tower fen, spur 4, carpet, collar 4

ZF3cL1 = zoltai fen, spur 3, carpet, collar 1
ZF3cL2 = zoltai fen, spur 3, carpet, collar 2
ZF3cL3 = zoltai fen, spur 3, carpet, collar 3
ZF3pL4 = zoltai fen, spur 3, pool, collar 4
ZF3pL5 = zoltai fen, spur 3, pool, collar 5
```

7.1.2 Spatial Coverage Map
None given.

7.1.3 Spatial Resolution
The 24 collars spanned the full range of hydrologic, plant community, and water chemistry gradients found in the larger peatland complex. They were placed along those gradients at each of the four subsites to capture the spatial variability in CO_2 fluxes.

7.1.4 Projection
Not applicable.

7.1.5 Grid Description
Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage
The chamber NEE measurements were made from 06-June-1994 to 02-September 1994 and 15-April-1996 to 23-October-1996. Associated water table and temperature measurements were recorded as well but are provided in a separate data set.

7.2.2 Temporal Coverage Map
Not applicable.

7.2.3 Temporal Resolution
The chamber NEE measurements for 15 of the collars were made approximately every 7 days.

7.3 Data Characteristics

7.3.1 Parameter/Variable
The parameters contained in the data files on the CD-ROM are:

```
         Column Name
-----------------------------
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
COLLAR_ID
DOWN_PAR
CO2_FLUX
PHOTOSYNTHETIC_RATE
RESPIRATION
CRTFCN_CODE
REVISION_DATE
```

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
TIME_OBS	The Greenwich Mean Time (GMT) when the data were collected.
COLLAR_ID	A TGB designation for the chamber collar sites, in the form of A-BBB-##, where A = C or M (Crill or Moosavi), BBB denotes the site, and possibly microtopographic designation, and ## is a sequention collar number.
DOWN_PAR	Incoming photosynthetically active radiation.
CO2_FLUX	Carbon Dioxide flux.
PHOTOSYNTHETIC_RATE	Measured Net Photosynthesis
RESPIRATION	Net ecosystem exchange of CO2 under dark conditions.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

The measurement units for the parameters contained in the data files on the CD-ROM are:

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
COLLAR_ID	[none]
DOWN_PAR	[Watts][meter^-2]
CO2_FLUX	[micromoles][meter^-2][second^-1]
PHOTOSYNTHETIC_RATE	[micromoles][meter^-2][second^-1]
RESPIRATION	[micromoles][meter^-2][second^-1]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

Column Name	Data Source
SITE_NAME	Not applicable
SUB_SITE	Not applicable
DATE_OBS	Investigator
TIME_OBS	Investigator
COLLAR_ID	Investigator
DOWN_PAR	LI-6200 portable photosynthesis system
CO2_FLUX	LI-6200 portable photosynthesis system
PHOTOSYNTHETIC_RATE	LI-6200 portable photosynthesis sys
RESPIRATION	LI-6200 portable photosynthesis sys
CRTFCN_CODE	Not applicable
REVISION_DATE	Not applicable

7.3.5 Data Range

The following table gives information about the parameter values found in the data files on the CD-ROM.

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	NSA-FEN-FLXTR	NSA-FEN-FLXTR	None	None	None	None
SUB_SITE	TGB03-FLX01	TGB03-FLXZF	None	None	None	None
DATE_OBS	06-JUN-94	23-OCT-96	None	None	None	None
TIME_OBS	0	2200	None	None	None	None
COLLAR_ID	CB-01	ZF3-hw	None	None	None	None
DOWN_PAR	0	2068	None	None	None	None
CO2_FLUX	-8.53	14.87	None	None	None	None
PHOTOSYNTHETIC_RATE	-.05	19.65	None	None	None	Blank
RESPIRATION	-8.53	.06	None	None	None	Blank
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	10-FEB-97	21-NOV-97	None	None	None	None

Minimum Data Value -- The minimum value found in the column.
Maximum Data Value -- The maximum value found in the column.
Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.
Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the parameter value, but the value was deemed to be unreliable by the analysis personnel.
Below Detect Limit -- The value that indicates parameter values below the instruments detection limits. This is used to indicate that an attempt was made to determine the parameter value, but the analysis personnel determined that the parameter value was below the detection limit of the instrumentation.
Data Not Cllctd -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BORIS combined several similar but

```
                    not identical data sets into the same data base table
                    but this particular science team did not
                    measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.
N/A   -- Indicates that the value is not applicable to the respective column.
None  -- Indicates that no values of that sort were found in the column.
-------------------------------------------------------------------------------
```

7.4 Sample Data Record

The following are wrapped versions of sample data records from a selected file on the CD-ROM:

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,COLLAR_ID,DOWN_PAR,CO2_FLUX,
PHOTOSYNTHETIC_RATE,RESPIRATION,CRTFCN_CODE,REVISION_DATE
'NSA-FEN-FLXTR','TGB03-FLXZF',06-JUN-94,0,'ZF3cL1',325.0,.00131663,,,'CPI',
10-FEB-97
'NSA-FEN-FLXTR','TGB03-FLXZF',06-JUN-94,0,'ZF3cL3',362.0,.00144591,,,'CPI',
10-FEB-97
```

8. Data Organization

8.1 Data Granularity

The smallest unit of orderable data is the NEE measurements, temperatures, water level, and plant community characterization for a given site on a given day.

8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

None.

9.1.1 Derivation Techniques and Algorithms

Not applicable.

9.2 Data Processing Sequence

9.2.1 Processing Steps

CO_2 (NEE) data were downloaded from the LI-6200 datalogger to laptop computers in the Heritage North Museum lab every day after returning from the field. The data were entered into spreadsheets, and the average flux for the 2.5-minute runs were calculated. Ancillary data that were recorded during the runs and included on the data sheets were number of sample runs, time interval for calculating flux rate, temperature of the chamber, relative humidity, and chamber volume. Data on leaf measurements, stomatal conductance, stomatal resistance, etc., were not relevant to this study. Temperature and water table data from the CR10 and CR7 dataloggers were downloaded every 3-4 days and entered into the spreadsheets at the lab.

9.2.2 Processing Changes

Not applicable.

9.3 Calculations

If -888 is present in the data set, it indicates that a measurement was taken, but was discarded for some reason. If -999 is present, then no data were taken.

9.3.1 Special Corrections/Adjustments

Not applicable.

9.3.2 Calculated Variables

Not applicable.

9.4 Graphs and Plots

None given.

10. Errors

10.1 Sources of Error

Placing the chamber down with much force can change the pressure inside the chamber to other than ambient and can affect the mechanisms and processes producing/taking up CO_2. (Errors such as this would have been written down in the lab/field books and these data therefore would have been edited out.)

10.2 Quality Assessment

10.2.1 Data Validation by Source

None given.

10.2.2 Confidence Level/Accuracy Judgment

Not applicable.

10.2.3 Measurement Error for Parameters

None given.

10.2.4 Additional Quality Assessments

Not applicable.

10.2.5 Data Verification by Data Center

Data were examined for general consistency and clarity.

11. Notes

11.1 Limitations of the Data
None given.

11.2 Known Problems with the Data
None given.

11.3 Usage Guidance
Not applicable.

11.4 Other Relevant Information
Not applicable.

12. Application of the Data Set

The chamber flux data can be used in connection with the tower flux data to determine the CO_2 exchange between the atmosphere and the peatland soils. The remote sensing images, the chamber plant community data, and the chamber NEE data can be used to scale the CO_2 fluxes from the plot scale to wetland landscape.

13. Future Modifications and Plans

None.

14. Software

14.1 Software Description
Not applicable.

14.2 Software Access
Not applicable.

15. Data Access

The NSA fen NEE data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information
For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

Not applicable.

17.2 Journal Articles and Study Reports

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

Sellers, P. and F. Hall. 1996. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1996-2.0, NASA BOREAS Report (EXPLAN 96).

Sellers, P., F. Hall, and K.F. Huemmrich. 1996. Boreal Ecosystem-Atmosphere Study: 1994 Operations. NASA BOREAS Report (OPS DOC 94).

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. Bulletin of the American Meteorological Society. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. Journal of Geophysical Research 102(D24): 28,731-28,770.

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None given.

19. List of Acronyms

AES	- Atmospheric Environment Services, Canada
ASCII	- American Standard Code for Information Interchange
BOREAS	- BOReal Ecosystem-Atmosphere Study
BORIS	- BOREAS Information System
BP	- Beaver Pond site, NSA
CB	- Collapse Bog
CD-ROM	- Compact Disk-Read-Only Memory
CF	- Collapse Fen
CMDL	- Climate Monitoring and Diagnostics Laboratory
DAAC	- Distributed Active Archive Center
DCE	- Data Communication Equipment
DTE	- Data Terminal Equipment
ECD	- Electron Capture Detector
EOS	- Earth Observing System
EOSDIS	- EOS Data and Information System
FID	- Flame Ionization Detector
GC	- Gas Chromatograph
GIS	- Geographic Information System
GSFC	- Goddard Space Flight Center
HTML	- HyperText Markup Language
IRGA	- Infrared Gas Analyzer
LI-6200	- LI-COR portable photosynthesis system
NASA	- National Aeronautics and Space Administration
NEE	- Net Ecosystem Exchange of CO2
NSA	- Northern Study Area
OBS	- Old Black Spruce
OJP	- Old Jack Pine
ORNL	- Oak Ridge National Laboratory
PANP	- Prince Albert National Park
PAR	- Photosynthetically Active Radiation
SSA	- Southern Study Area
TCD	- Thermal Conductivity Detector

```
TF      - Tower Fen
TGB     - Trace Gas Biogeochemistry
UNH     - University of New Hampshire
URL     - Uniform Resource Locator
YJP     - Young Jack Pine site, NSA
ZF      - Zoltai Fen
```

20. Document Information

20.1 Document Revision Date

Written:
Last Updated: 11-Jun-1999

20.2 Document Review Date(s)

BORIS Review: 10-Mar-1998
Science Review:

20.3 Document ID

20.4 Citation

When using these data, please contact the investigators listed in Section 2.3 and cite any relevant papers in Section 17.2.

If using data from the BOREAS CD-ROM series, also reference the data as:

Bubier, J.L., P.M. Crill, and T.R. Moore, "Magnitude and Control of Trace Gas Exchange in Boreal Ecosystems." In Collected Data of The Boreal Ecosystem-Atmosphere Study. Eds. J. Newcomer, D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers. CD-ROM. NASA, 2000.

Also, cite the BOREAS CD-ROM set as:

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM. NASA, 2000.

20.5 Document Curator

20.6 Document URL

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	November 2000	Technical Memorandum

4. TITLE AND SUBTITLE
Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)
BOREAS TGB-1/TGB-3 NEE Data over the NSA Fen

5. FUNDING NUMBERS
923
RTOP: 923-462-33-01

6. AUTHOR(S)
Lianne Bellisario and Tim R. Moore
Forrest G. Hall and Sara K. Conrad, Editors

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS (ES)
Goddard Space Flight Center
Greenbelt, Maryland 20771

8. PEFORMING ORGANIZATION REPORT NUMBER
2000-03136-0

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS (ES)
National Aeronautics and Space Administration
Washington, DC 20546-0001

10. SPONSORING / MONITORING AGENCY REPORT NUMBER
TM—2000–209891
Vol. 225

11. SUPPLEMENTARY NOTES
L. Bellisario: Atmospheric Environment Service; T.R. Moore: McGill University, Montreal, Quebec; S.K. Conrad: Raytheon ITSS

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Unclassified–Unlimited
Subject Category: 43
Report available from the NASA Center for AeroSpace Information,
7121 Standard Drive, Hanover, MD 21076-1320. (301) 621-0390.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The BOREAS TGB-1 and TGB-3 teams collected several data sets that contributed to understanding the measured trace gas fluxes over sites in the NSA. This data set contains NEE measurements collected with chambers at the NSA fen in 1994 and 1996. Gas samples were extracted approximately every 7 days from chambers and analyzed at the NSA lab facility. The data are provided in tabular ASCII files.

14. SUBJECT TERMS
BOREAS, trace gas biogeochemistry.

15. NUMBER OF PAGES
17

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL